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THE EFFECT OF AUDIT RATES ON FEDERAL INCOME TAX FILINGS AND COLLECTIONS, 1977–1986

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ABSTRACT

This paper analyzes the effects of audit rates and certain other factors on federal income tax filings and collections. Using data drawn primarily from the *Annual Reports of the Commissioner of Internal Revenue* for the years 1977–1986, we investigate the overall performance of the federal revenue collection process and estimate that total IRS collections in 1986 would have risen by approximately forty billion dollars had the federal audit rate remained constant at its 1977 level during the intervening period.

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1. INTRODUCTION

The decade 1977–1986 witnessed a dramatic decrease in the Internal Revenue Service ("IRS") audit rate. The audit rate for individuals declined from about 2 1/2 percent to just over one percent during this period. Audit rates of corporations declined even more precipitously, from about 9 1/2 percent to around 3 percent. Although exact comparisons are not possible due to changes in IRS classifications of taxpayers, audit rates of higher income individuals declined substantially. With the exception of a burst in activity for tax shelter partnerships in the early 1980s, partnership and small business corporation audit rates reflect a similar downward trend. The declines in audits seem principally due to two factors: first, they were a natural consequence of the budget policies of the period and second, the IRS seemed to adopt a policy of substituting third–party information reporting coupled with IRS document matching and increased taxpayer and tax preparer penalties for an audit–dependent enforcement policy.[1]

A consensus seems to have emerged that relatively little additional revenue would be produced from increased tax enforcement, although President Bush's budget for fiscal years 1991–1995 includes $5.6 billion of additional revenues increased IRS enforcement funding and improved IRS management. The strengthening in the 1980s of third–party information reporting of tax–related transactions to the IRS and IRS matching of such reports to tax returns means that few effective opportunities for effective third party reporting remain.[2]

Penalties for underreporting tax liabilities also underwent drastic revisions during the past decade and the 1989 penalty revision legislation suggests that further penalty increases are not feasible. The 1989 restructuring of taxpayer penalties seems to reflect agreement that the severity of the penalty structure of the 1980s, in combination with a historically low audit rate, created

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1. For further development of this point see Dubin, Graetz, and Wilde (1989).

2. Indeed, ignoring W–2 forms, the number of information reports per return filed for individuals rose from around 3.5 in 1977 to just over 6 in 1985.

unfairness in the tax compliance process.[3]

The primary purpose of this paper is to investigate empirically the overall role of audits in the federal revenue collection process. Surprisingly, this has never been done. Although the general deterrence effects of audits have been widely acknowledged, the IRS never has put forth any estimates of the "spillover" benefits of audits (the increase in collections from taxpayers, whether or not they are audited, who report more taxes due in response to an increase in the likelihood of an audit). To date, only the the direct revenues obtained from audits (additional taxes and penalties) have been estimated.

The principal innovation in our empirical work is directly to estimate collections rather than first attempting to construct a measure of noncompliance, and then extrapolating from noncompliance to revenue. This is consonant with the theoretical literature, in which taxpayers typically decide on an optimal level of reported income as opposed to an optimal level of noncompliance (although the difference is largely semantical).

In particular, our empirical analysis is based on two models, both of which are estimated using a state-level, time series cross-section data set for the years 1977-86. One model specifies IRS collections per return filed as a function of audit rates, rates of issuance of CP2000s (computer generated IRS notices informing taxpayers that additional taxes are due, principally as a result either of IRS matching of third party information reports with tax returns or of return consistency checks, such as those for mathematical accuracy), and a variety of socio-economic factors. The other model specifies returns filed per capita as a function of the same variables. This decomposition of total collections into collections per return filed and returns filed per capita allows us to separate the effects of underlying explanatory variables on total collections into a "collections effect" and a "filings effect."

In addition, the time–series nature of our data allows us to investigate the overall performance of the federal revenue collection process during the decade 1977–86. We explore the relationship between audit rates and tax collections by asking what would have happened to total IRS collections from individuals had the audit rate remained constant at its 1977 level over the period 1977–86. We estimate that total IRS collections would have been greater by 41.4 billion dollars in 1986, or about 7 percent of total individual collections, had the audit rate remained constant at its 1977 level. Although changes in collections during the last decade necessarily reflect a variety of other tax compliance factors—-most notably the dramatic increases in third–party information reporting and the IRS's ability to match such information to tax return submissions, as well as the substantial new

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3. See § § 7711–7743 of P. L. 101–239 ("The Improved Penalty Administration and Compliance Tax Act of 1989"). See also, e.g., Testimony of Michael J. Saltzman, Charles J. Muller and James E. Merrett on behalf of the Penalties Task Force of the section of Taxation of the American Bar Association, before the Subcommittee on Oversight, Committee of Ways and Means, U.S. House of Representatives, July 28, 1988.

4. In estimating additional collections, we are to some extent treating additional taxes and penalties recommended by the IRS on audit as fully collectible. To the extent that these amounts are reduced by subsequent settlement negotiations or an inability of the IRS to collect taxes due actual collections would be lowered.

and increased penalties enacted by congress in 1981 and 1982--our results confirm the prominence of audit rates in the revenue collection process. These findings have important policy implications for tax administration, and generally confirm an economic approach to tax noncompliance: taxpayers do seem to respond rationally, even predictably, to the nature of the tax lottery confronting them.

We not only estimate the total decrease in IRS collections from individuals due to the fall in audit rates over the period 1977–1986, but we are also able to separate that estimate into an amount attributable to the lost additional tax and penalties that would have been collected directly from audits and an amount attributable to spillover effects. In particular, spillover effects constitute 34.4 billion dollars out of the total 41.4 billion dollars. The spillover effects of increases in audit rates therefore produce roughly five out of every six dollars of additional revenues.

Finally, we have a number of results regarding taxpayer filing behavior. Most significantly, we find that increases in the audit rate decrease returns filed per capita and increases in the percent of the adult population with at least a high school education increase significantly the number of returns filed per capita. These findings shed new light on compliance factors related to nonfilers, a significant tax compliance category that heretofore has been largely unexplored.

The remainder of this paper is organized as follows. Section 2 describes our data and estimation procedures. Section 3 presents our results on the effect of audit rates on individual tax collections for the years 1977–1986 and summarizes other empirical results of general interest. Section 4 concludes with some brief comments on the policy implications of our results.

2. EMPIRICAL ANALYSIS

Our empirical analysis generates estimates of the effects of federal audit rates on collections per return and on returns filed per capita. We also estimate the relationship between state tax rates and various socio–economic factors and total federal income tax collections. We specify a model in which collections per return depends on the state tax rate, the audit rate, the rate of issuance of CP2000s, per capita income, and various other socio–economic variables. We also specify a second model which relates federal returns filed per capita to the same variables.

2.1 Data

Our data is drawn from a variety of sources, but the core of our analysis is based upon on data reported in the *Annual Reports of the Commissioner of Internal Revenue* for the years 1977–1986, which covers the government fiscal years, running from October 1 to September 30, 1977–86.[5] These reports include district level data on Internal Revenue Service collections, number of returns

5. We have attempted to extend our analysis to 1977–88, as data from the *Annual Reports of the Commissioner of Internal Revenue* for the years 1987 and 1988 has become available. However, several anomalies in the collections data have frustrated this effort. For example, between 1986 and 1987, total individual collections as reported by the IRS rose from $2.69 billion to $3.86 billion in Arkansas and from $4.41 billion to $6.24 billion in Kentucky, while independent Bureau of Economic Analysis estimates of per capita income only rose from $11,136 to $12,705 in Arkansas and from $17,741 to

filed, amount and number of refunds, number of examinations, total additional tax and penalties recommended after examination, and budgets. The data is further broken down by "class of tax"—individual, corporate, estate, gift, etc. For most states, the whole state is one IRS district. Until 1984 California, Illinois, Ohio, Pennsylvania and Texas each had two districts and New York had four. In 1984 another district was added to Texas and three were added to California. In all cases of multiple districts within a state, we aggregate district level data from the annual reports to the state level.

Our present analysis focuses on the federal individual income tax. In the annual reports, individual taxes include returns with Schedule C or F present (nonfarm business or farm) but vary over the years as to whether partnership returns are included. Given the importance of tax shelter investments for tax compliance in the years investigated here, and the reporting of tax shelter losses on partnership returns as well as on Schedules C and E of individual returns, we aggregate partnership with individual returns whenever the annual reports do not do so.

While, in theory, other data might better facilitate the analysis we have undertaken here, a variety of limitations restrict our ability to use less aggregate data sources. Probably the best data base would consist of a sample of individual tax returns over this time period, but section 6103 of the Internal Revenue Code limits the IRS ability to releasing such individual level data and section 7216 of the Code similarly prohibits the use of such individual level data collected by tax return preparers. The IRS, from time to time, has made Taxpayer Compliance Measurement Program ("TCMP") data—data that involves a stratified sample of intensive IRS audits—available to researchers, but such data is typically aggregated in some fashion.[6] While we ourselves have used such data in other inquiries,[7] the data used here—from the Commissioner's annual reports merged with state level data from other sources—permit us to explore a wide variety of questions. In particular, we not only derive estimates of the effect of audits on revenues, but also disaggregate such estimates into the direct and indirect (or spillover) components.

We use the following seven primary variables from the annual reports: (1) total collections from individual income and employment taxes;[8] (2) total refunds to individuals; (3) total tax returns filed;[9] (4) number of individual income tax returns filed; (5) number of individual income tax returns

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$18,401 in Kentucky. Such dramatic increases in collections cannot be explained by increases in tax rates and are inconsistent with small increases in per capita income reported by the BEA.

6. Individual return data generally is not available. When the IRS does make such data available to non–IRS researchers it tends to be cross–sectional and is seldom matched with socio–economic data. A recent exception to the latter is provided by Tauchen, Witte, and Baron (1989). These authors analyze a data set which combines 1979 TCMP data with IRS administrative records and socio–economic data from the 1980 Census, matched at the 5–digit zip code level. Their results generally confirm those obtained herein, although, where comparable, the magnitude of effects is weaker in their case.

7. For example, Dubin, Graetz, Udell, and Wilde (1989) use 1979 TCMP data aggregated to the IRS district level to analyze taxpayers' decisions to use tax preparers.

8. This variable, as we define it, includes any additional tax and penalty assessed as the result of examinations. It also includes employment taxes as these are not reported separately by the IRS.

9. Prior to 1981 virtually all nonprofit organizations filed in Delaware. Starting in 1981 they began to file in the district of primary activity. We have therefore subtracted nonprofit returns filed from total returns filed (the former amounts to less than 2 percent of the latter). Also, prior to 1981 "declarations of estimated tax" were recorded as one entry per year for any taxpayer filing a declaration of estimated tax in any quarter. Starting in 1981 each quarterly form was counted as one entry, increasing the number of declarations of estimated tax by a factor of four. We have adjusted "total returns filed" in 1981–85

examined; (6) additional tax and penalties recommended after examination for individual income tax returns; and (7) costs incurred by the Internal Revenue Service.[10]

Using these seven primary variables, we construct four secondary variables which are used in our analysis:

ICR: total collections from individual income and employment taxes divided by the number of individual income tax returns filed, in 1972 dollars—individual collections per return;
RCAP: total individual income tax returns filed divided by total population—returns per capita;
IAR: total individual income tax returns examined divided by total individual income tax returns filed—the individual audit rate;
BPR: total IRS budget divided by total returns filed, in 1972 dollars—budget per return.

We also use a number of social-economic variables taken from a variety of sources. These are all reported by calendar year:

STAXR: total state income tax paid as a percentage of total state income—the average state income tax rate;
MTAXR: the maximum statutory marginal state income tax rate;
PERED: percent of the adult population with at least a high school education;[11]
PER45: percent of the adult population between 45 and 65 years old;
PER65: percent of the adult population over 65 years old;
UR: the unemployment rate;
PICAP: per capita income, in 1972 dollars;
PMAN: percent of the work force employed in manufacturing;
PSERV: percent of the workforce employed in the service industry.

The employment and unemployment variables are included as they reflect opportunities to evade. The age and education variables are included because other studies, primarily surveys, suggest that they are important.[12] Finally, we expect that audit rates and compliance levels, as reflected in collections and filings, are related but consider it fundamental to allow for the possible endogeneity of audit rates. Endogeneity occurs when elements of a taxpayer's income and tax status which are known by the taxpayer and observed by the IRS (but not by us) induce below average compliance and simultaneously induce greater audit rates. In this case, correlation between audit

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to account for this.

10. We have ignored the approximately one to two percent of "examinations" that take place at seven "regional service centers," each of which covers six to eight states. Thus "number of returns examined," "additional tax and penalty," and "costs" include only the district level figures from the annual reports.

11. We get the percent of the adult population with at least a high school education from Census data for 1976 and 1980 and interpolate for 1977, 1978, and 1979. For 1981 through 1985 we combine data on the number of high school graduates with other demographic data to construct projections based on the 1980 values.

12. Witte and Woodbury (1983) and Cowell (1985) provide reviews of the literature which suggest that these variables are important. See also Dubin and Wilde (1988).

rates and the unobservables will lead to inconsistent estimates of the parameters using ordinary least squares estimation. Consistent estimation then requires the use of an "instrument" which is correlated with audit rates but not with the unobservables. The IRS budget per tax return filed, BPR, fills this role in our analysis, as is described in detail in the next section.

Total state income taxes are taken from *State Government Tax Collections* 1977–1986, published by the U.S. Department of Commerce. We divide this variable by total state income to get the average state tax rate. The average state tax rate, so constructed, may be correlated with unobserved factors that determine federal collections or returns filed. This potential endogeneity again may be accounted for through the use of an appropriate instrument. In this case we use the maximum statutory marginal tax rate, taken from *Significant Features of Fiscal Federalism*, 1977–1986, published by the U.S. Advisory Commission on Intergovernmental Relations. The latter is clearly exogenous as it is set legislatively and is not behaviorally determined. Furthermore, it is highly correlated with the average state tax rate.

Finally, we have obtained from the IRS regional level data on the number of CP2000's issued. This allows us to construct another enforcement variable, which takes on common values for all states with a region:

CPRATE: the number of CP2000's issued divided by individual returns filed.[13]

As with audit rates, the rate of issuance of CP2000s may be endogenous. To allow for this fact, we construct a final variable based on the number of documents issued by third parties reporting information to the IRS:

INFRATE: the number of information returns filed divided by the number of individual returns filed.[14]

As with CPRATE, INFRATE takes on common values for all states within a region. It is a natural instrument for CPRATE since most CP2000s are issued on the basis of the IRS's Information Returns Program, and compliance by third parties with this program is out of the control of individual taxpayers.

The mean values of all variables and their standard deviations are given by year in Table 1.

2.2 Estimation

We pool state level data for the years 1977 to 1986 and estimate ICR and RCAP as functions of one-year lagged values of IAR, STAXR, PER45, PER65, PERED, UR, PICAP, PMAN, PSERV, and CPRATE and a time trend (TIME) for the years 1978-1986.[15]

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13. Because the issuance of CP2000s is not, unlike routine audits, a process which is performed uniformly during the year, we have used a two-year moving average of the raw CP2000 data to construct CPRATE.

14. As with CPRATE, we use a two-year moving average of the information returns data to construct INFRATE.

15. Our analysis is conducted on a "cash-flow" basis since collections per return and returns filed per capita are reported by fiscal year, not by tax year. In this case it is appropriate to lag all explanatory variables by one year.

$$ICR_{it} = \alpha_0 + \alpha_1 IAR_{it-1} + \alpha_2 STAXR_{it-1}$$
$$+ \alpha_3 PER45_{it-1} + \alpha_4 PER65_{it-1} + \alpha_5 PERED_{it-1}$$
$$+ \alpha_6 UR_{it-1} + \alpha_7 PICAP_{it-1} + \alpha_8 PMAN_{it-1}$$
$$+ \alpha_9 PSERV_{it-1} + \alpha_{10} CPRATE_{it-1} + \varepsilon_{it}^{ICR} \quad (1)$$

$$RCAP_{it} = \beta_0 + \beta_1 IAR_{it-1} + \beta_2 STAXR_{it-1}$$
$$+ \beta_3 PER45_{it-1} + \beta_4 PER65_{it-1} + \beta_5 PERED_{it-1}$$
$$+ \beta_6 UR_{it-1} + \beta_7 PICAP_{it-1} + \beta_8 PMAN_{it-1}$$
$$+ \beta_9 PSERV_{it-1} + \beta_{10} CPRATE_{it-1} + \varepsilon_{it}^{RCAP} \quad (2)$$

The estimation of equations (1) and (2) is complicated by several statistical considerations. First, as noted above, we expect that the lagged audit rate, IAR_{it-1}, is correlated with the unobservable factors that influence collections per return, ε_{it}^{ICR}, and with the unobservable factors that influence returns filed per capita, ε_{it}^{RCAP}. We employ a single-equation consistent estimation procedure to estimate equations (1) and (2) using the lagged budget per return, BPR_{it-1}, as an instrument for IAR_{it-1}.[16] We

16. A substantial theoretical literature devoted to taxpayer behavior developed in the tradition of Gary Becker's classic 1968 article on the economics of crime, beginning a few years later with the publication of papers by Allingham and Sandmo (1972) and Srinivasan (1973). The consensus of this literature is that increasing the probability of audit or the penalty rate for underreporting tax liabilities will unambiguously reduce noncompliance, but that little else can be said conclusively regarding the effects on noncompliance of other factors such as income or tax rates (see, in particular, Yitzhaki, 1974 or, more generally, reviews by Witte and Woodbury, 1983, and Cowell, 1985).

The problem with models developed in the Becker tradition is that they ignore elements of the revenue collection process that need to be incorporated into any reasonable empirical specification of a compliance model. In particular, if audit rates and punishment levels are included as explanatory variables, some account must be taken of their potential endogeneity. This is a point which the empirical literature on crime, in contexts other than tax law, has taken into account (see, e.g. Pyle, 1986), but in the empirical literature on tax compliance often has been ignored (e.g. Witte and Woodbury, 1985) or inadequately dealt with (e.g., Clotfelter, 1983; Crane and Nourzad, 1986). As noted in the text, we use IRS budgets per return to identify the audit effect (see Dubin and Wilde, 1988).

In another recent paper, Alm, Bahl and Murray (1989) analyze a random sample from all Jamaican individual income tax returns, and a subsample of audited returns selected from that sample. They estimate a two-stage tobit model using a dununy variable for whether a return was audited in the first stage, and in the second stage using the detected reported income as a dependent variable, with a selectivity correction for having been audited. Alm, Bahl and Murray find that the probability of an audit increases with reported tax liability, capital losses and tax credits, while it decreases with dividend and wage income. Unreported taxes increase with the predicted probability of being audited, marginal tax rates, higher levels of post-audit after-tax income (a proxy for true income) and self-employment income, but decrease with

also use the appropriately lagged rate of filing of information returns, $INFRATE_{it-4}$, as an instrument for $CPRATE_{it-1}$.[17]

Finally, our estimation procedure accounts for possible correlation of the unobservables ε_{it}^{ICR} and ε_{it}^{RCAP} over time. Inspection of the fitted residuals obtained using preliminary instrumental variables estimation indicated a correlative pattern consistent with the random components model (Maddala, 1971). This form of the error distribution implies a specific dependence of the unobservables over time. In particular, the random components model postulates a random error specific to a given state but constant over time:

$$\varepsilon_{it}^{ICR} = \eta_i^{ICR} + \xi_{it}^{ICR} \tag{3}$$

$$\varepsilon_{it}^{RCAP} = \eta_i^{RCAP} + \xi_{it}^{RCAP}. \tag{4}$$

To account for the dependence in the unobservables, we form the optimally weighted average of between- and within-group estimates to obtain the generalized least squares (GLS) estimator. GLS estimation of this type provides more than a gain in efficiency. Not adjusting for random effects may lead to incorrect inferences regarding endogeneity and the apparent insignificance of some structural effects. The optimal weighting of first stage estimates is calculated by a simple transformation of the estimated standard errors from between- and within-group estimators (Maddala, 1971). Given the potential endogeneity of audit and state tax rates, we use instrumental variables to obtain consistent estimates of the error components.[18]

GLS estimates were obtained by subtracting a fraction θ of the mean value of each variable by state from each observation of that variable within that state. The constant θ is a function of the error variances of between and within-group estimators, with adjustments made for degrees of freedom.[19] Transformation of the data into Gauss-Markov form then allows us to test for the presence of endogeneity and to construct consistent and efficient estimates of the parameters, which we refer to below as IV-GLS estimates.

The results of the estimation are provided in Tables 2 and 3. Table 2 presents the results for the collections per return equation (1) and returns filed per capita equation (2). Table 3 presents

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higher levels of wage, dividend, or rental income.

17. There is generally a substantial delay between the time third party reports are received by the IRS and the time they are matched to individual taxpayers and CP2000s are issued. We follow the timing of the actual audit cycle and use INFRATE lagged three years to instrument CPRATE.

18. Within-group estimation, or equivalently fixed-effects, does not account for variation across states and is therefore not fully efficient. This last point notwithstanding, we have performed specification tests on the fixed-effects models and have detected the continued presence of endogenous enforcement variables. This suggests that at least some portion of the endogeneity of the audit and CP2000 rates are due to correlation with the unobserved non-individual specific error. This precludes the use of other estimation methods which seemingly are appropriate in this context, including, for example, that suggested by Hausman and Taylor (1981).

19. For the audit rate equation $\theta = .687$, for the CP2000 rate equation $\theta = .319$, for the individual collections equation $\theta = .708$, and for the returns filed equation $\theta = .885$.

reduced form equations for the audit rate and CP2000 rate.

3. RESULTS

3.1 Audit Rates

The audit rate is endogenous in both the collections equation and the returns filed equation: the Hausman statistic for the former is 3.21 while for the latter it is -3.53. As expected, the audit rate is significantly influenced by the IRS budget per return, with respect to which it is increasing. Also as expected, the audit rate is decreasing in the percent employed in manufacturing and is increasing in the percent employed in the service industry. It is independent of income per capita and the percent of the population over 65, but is decreasing in the percent of the adult population between 45 and 65 years old. It is independent of the unemployment rate but increasing in the percent of the adult population with a high school education. Finally it is independent of the information returns rate.

With respect to collections per return, the audit rate has a significant positive effect. As we show below, this is the case even when the additional tax and penalty associated with examinations is subtracted from total collections. We interpret the positive effect of the audit rate on collections per return as arising from increased compliance and consider it to be strong evidence of the deterrent effect of audits on taxpayer noncompliance. On the other hand, audits bear a negative relationship to returns filed per capita. This result can be explained, possibly, by the fact that routine IRS audits are not an effective mechanism for locating nonfilers. Thus, historically at least, one way to escape audits has been simply not to file.

We have conducted some experiments based on our estimates which examine the intertemporal effects of declining audit rates. Using the IV-GLS estimates from Table 2, we have calculated for each year the predicted value of total collections from individual returns that would have been realized had the audit rate remained constant at its 1977 level. By 1986 we estimate that maintaining the audit rate at its 1977 level would have increased collections by 41.4 billion 1986 dollars, or 7 percent of total individual collections in 1986 (net of refunds).[20]

We are also able to isolate and estimate the indirect revenue effect of audits. To do this, we subtract the additional taxes and penalties resulting from IRS examinations from total IRS collections (net of refunds), for each state in each year, and divide by the number of individual returns filed in order to generate a collections per return variable which does not include the revenue produced by the examinations process. We then repeat our IV-GLS estimation using this as the dependent variable, and calculate a predicted value for the increase in total individual collections for 1986 that would have resulted from holding audit rates at their 1977 levels. This value, 34.4 billion dollars, is 83 percent of our original estimate, which included the additional tax and penalty resulting from IRS examinations. Thus it represents the indirect revenue effect---or spillover effect---of the increase in audit rates.[21]

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20. The average audit rate fell from 1.8 percent to 1.1 percent over this period

21. Tauchen, Witte, and Beron (1989) also find a significant spillover effect of audits. However, their estimates yield indirect revenue effects approximately equal to direct revenue effects.

3.2 The CP2000 Rate

A CP2000 is an automatic computer notice informing a taxpayer that taxes are due based on information reported by third parties or IRS checks of the return for internal consistency. As such, one might expect, a priori, that increases in CP2000's issued would have a deterrent effect on noncompliance; i.e., they would increase collections per return (but not necessarily returns filed per capita). At the same time, states with greater noncompliance might be expected to have higher CP2000 rates, generating an endogeneity issue. Indeed, the Hausman statistic for endogeneity of the CP2000 rate in the collections per return equation is 1.97 and in the returns filed per capita equation it is 4.41. (These values are significant at the 5 percent level.) However, after allowing for endogeneity of the CP2000 rate, we find no significant relationship between it and collections per return and a positive relationship between it and returns filed per capita.

A comparison between our results for the CP2000 rate and our results for the audit rate sheds additional light on current IRS enforcement strategies. As the reduced form estimates given in Table 3 indicate, the two enforcement tools are quite different. In particular, CP2000s do not appear to act as substitutes for traditional audits with respect to collections, despite the common assertion that the increase in the CP2000 rate in recent years has mitigated the undesirable implications of the dramatic fall in audit rates.[22]

3.3 Tax Rates

Forty-three states currently have state income taxes. In all these states there is substantial overlap between the information relevant for federal and state income tax computations. Taxpayers can be expected to coordinate their reports of relevant tax items, including, for example, income and deductions, on their federal and state income tax returns, and they likely will perceive there to be a connection between the probability of audit for state and federal tax underreporting. Moreover, both state and federal returns are filed subject to penalties for perjury as well as for tax fraud. Taxpayers rightly therefore will expect that inconsistencies in reporting on federal and state returns will increase the risks of imposition of these harsher penalties for tax noncompliance that depend on the government's ability to prove that taxpayer's understatements were willful.

There also is a direct linkage among the activities of state and federal tax enforcement agencies. Congress and state legislatures have explicitly provided for exchanges of otherwise confidential tax return and other tax information between the states and the IRS "to increase tax revenues and taxpayer compliance and reduce duplicate resource expenditures."[23] We therefore expect that a strong correlation will exist between taxpayers' underreporting on federal and state

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22. Respecting the notion that audits and CP2000s may be substitutes, we have performed the following experiment. We define the "contact rate" as the sum of the audit rate and the CP2000 rate. We then reestimate our collections per return and returns filed per capita models using just the contact rate instead of both the audit rate and the CP2000 rate (this amounts to constraining the coefficients on the audit rate and the CP2000 rate to be equal). The contact rate is endogenous in both models but has much smaller coefficients than the coefficients on the audit rate in Table 2. Returning the audit rate to its 1977 level in this case yields an additional revenue estimate of only $12.6 billion.

returns.

Perhaps, surprisingly, we find that the average state income tax rate is not endogenous in either the collections equation or the returns filed equation: the Hausman statistic for the former is 1.17 while for the latter it is 1.39.[24] Furthermore, when treated as exogenous, in both equations the coefficient on STAXR is not statistically significant (the t-statistics are 0.18 and –0.56, respectively). This is of interest insofar as we do not find a negative effect of state income tax rates on collections per return at the federal level, a relationship that should be expected, other things equal, given the deductibility of state income taxes on federal returns during the period covered by this study.[25]

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23. Internal Revenue Service, Manual, *Disclosure of Information Handbook*, § (33) 00. For a generalization of Graetz, Reinganum and Wilde (1986) which introduces a state tax agency as a strategic actor in the tax compliance game see Dubin, Graetz and Wilde (1987). We find that as long as there is a linkage between the likelihood of audit at the state and federal levels, an increase in the state income tax rate increases compliance at the federal level. A recent cross-sectional study due to Cox (1986) also raises the issue of the effect of state income taxes on federal income tax compliance. Using 1979 TCMP data, but controlling only for income, he finds no systematic evidence of an effect of state tax rates on compliance.

24. We test for endogeneity of STAXR using the maximum statutory marginal tax rate (MTAXR) as an instrument. The reduced form equation for the average state income tax rate is generally uninteresting. Since statutory state income tax rates vary considerably across the states, virtually all the variation in STAXR for which we can account is explained by MTAXR.

25. We have constructed average marginal federal tax rates using techniques similar to those discussed by Barro and Sahasakul (1983). Since these do not take on separate values for each state, they are not distinguishable from general time effects as captured by the variable TIME.

Using individual return data and the results of actual IRS audits conducted as part of the 1979 IRS Taxpayer Compliance Measurement Program (TCMP), Clotfelter (1983) models underreported income as a function of effective marginal tax rates, after-tax income, wages as a proportion of adjusted gross income, interest and dividends as a proportion of adjusted gross income, and several socio-economic variables. Even though Clotfelter finds a negative relationship between his measure of the effective marginal tax rate and compliance, his analysis omits the audit rate because of potential simultaneity problems.

Crane and Nourzad (1986) analyze the effect of inflation on aggregate tax evasion over the period 1947-81, concluding that increases in the inflation rate or the marginal tax rate increase tax evasion. Their measure of tax evasion is based on the difference between the Adjusted Gross Income estimate derived by the Bureau of Economic Analysis and that reported by the IRS, their measure of the fine rate is the ratio of additional taxes and penalties assessed by the IRS to the amount of tax evaded, and their measure of true income is the same BEA estimate of adjusted gross income used to construct their measure of tax evasion. Their estimation allows for the simultaneity introduced by the construction of the latter, but not audit rates, fines, or marginal tax rates, the last of which are constructed using a technique similar to that of Clotfelter.

Alexander and Feinstein (1986), using 1982 TCMP data, find negative effects of marginal tax rates on compliance. Tax rates enter in their model through the probability of detection. Their equation for the probability of detection is assumed to be independent of their compliance equation, which leads them to estimate a recursive rather than simultaneous system. Their approach therefore is analogous to treating audit rates exogenously.

3.4 Socio–Economic Factors

Per Capita Income. As expected, increases in per capita income have a positive effect on collections per return and returns filed per capita. They have no effect on audit or CP2000 rates.

High-School Education. The percent of the adult population with at least a high school education is positively related to collections per return, returns filed per capita, and audit rates. An increase in the percent of the adult population with at least a high school education decreases the CP2000 rate.

Age. To test the effects of age, we employ two age variables, the percent of the adult population between 45 and 65 years old and the percent of the adult population over 65 years old. Only the former reflects a pure age effect since taxpayers over 65 are eligible for tax reductions. Increases in the percent of the adult population between 45 and 65 are positively associated with collections per return and negatively associated with audit rates. They have no effect on audit or CP2000 rates. Increases in the percent of the adult population over 65 show no discernible effects.

Employment Patterns. Increases in the unemployment rate have no apparent effect on collections per return or the audit rate. However, they reduce returns filed per capita. With respect to patterns of employment, we expect a positive association between compliance levels and percentage employment in manufacturing industries and a negative association between compliance levels and percentage employment in service industries---principally because of variations in withholding coverage. Our results are broadly consistent with these expectations. PMAN is positively related to collections per return and negatively related to the audit rate. PSERV is independent of collections per return and positively related to the audit rate. It is also positively related to returns filed per capita.

4. CONCLUSION

Our results corroborate the central role of audit rates in the revenue collection process. The impact of the decade-long fall in audit rates on tax collections seems to have been serious indeed. A budgetary practice of including IRS audit personnel within a general political philosophy limiting the desired size of government agencies is enormously costly. Additional dollars spent on tax audits appear to have substantial marginal productivity, a fact that might have heretofore been concealed by the aggregate stability of the federal revenue collection process over time.

With respect to socio-economic factors, the most interesting finding in this study is the strong positive relationship between high school education and returns filed per capita. This finding is significant since it provides the first real empirical insight into the population of nonfilers, about which very little is now known. It also suggests potential opportunities for IRS provision of information to the populace and highlights the significance of simplifying the return filing process.[26]

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26. In contrast, other studies have recommended tax simplification and increased information and taxpayer assistance

President Bush's Budget Proposals for fiscal year 1991 include additional IRS enforcement funding and estimates that such funding will produce about $5.5 billion of additional revenue during the next five years. In a somewhat similar vein, the Senate version of the 1986 Tax Reform Act would have created a special Tax Administration Trust Fund to ensure increases in IRS enforcement budgets in future years. This proposal was explicitly intended to address the Senate's concerns that the audit rate had fallen by half during the prior decade. The Senate Finance Committee's Report estimated that this trust fund would have produced $17.6 billion of additional revenues in the five fiscal years 1987-1991. These estimates were greeted skeptically and the proposal was not included in the 1986 act, as finally enacted. Our results here suggest that, if anything, the Senate's estimates understated, not overstated, the revenue impact of such a program. The IRS audit capacity deserves protection.

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without either specifying targets for such information or detailing why such efforts are likely to stimulate compliance. See, e.g., American Bar Association Commission on Tax Compliance, Report and Recommendations, July 1987.

TABLE 1: Mean Values of Variables by Year

(Standard errors in parenthesis)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
ICR	1.70	1.74	1.85	1.85	1.97	1.97	1.88	1.91	1.99	1.97
	(.70)	(.61)	(.62)	(.64)	(.72)	(.71)	(.68)	(.72)	(.73)	(.71)
RCAP	.40	.41	.42	.42	.42	.42	.42	.42	.43	.43
	(.034)	(.032)	(.033)	(.035)	(.033)	(.032)	(.034)	(.036)	(.037)	(.040)
IAR	1.88	1.77	1.66	1.66	1.53	1.40	1.36	1.23	1.15	1.00
	(.65)	(.59)	(.58)	(.58)	(.45)	(.35)	(.37)	(.38)	(.37)	(.43)
STAXR	1.66	1.65	1.66	1.61	1.58	1.63	1.70	1.80	1.77	1.75
	(1.16)	(1.08)	(1.05)	(1.04)	(1.06)	(1.12)	(1.16)	(1.17)	(1.12)	(1.10)
PERED	.67	.67	.67	.67	.68	.68	.67	.68	.68	.68
	(.073)	(.074)	(.075)	(.076)	(.077)	(.078)	(.080)	(.081)	(.083)	(.085)
PER45	.28	.28	.28	.27	.26	.26	.25	.25	.25	.25
	(.016)	(.016)	(.015)	(.018)	(.017)	(.016)	(.015)	(.014)	(.016)	(.016)
PER65	.15	.15	.15	.15	.16	.16	.16	.16	.16	.16
	(.029)	(.028)	(.029)	(.028)	(.028)	(.028)	(.028)	(.028)	(.029)	(.027)
UR	.066	.057	.055	.068	.073	.093	.093	.073	.071	.069
	(.016)	(.015)	(.014)	(.016)	(.019)	(.023)	(.025)	(.022)	(.019)	(.022)
PICAP	4.82	5.03	5.14	5.14	5.24	5.20	5.28	5.54	5.75	5.68
	(.69)	(.66)	(.65)	(.73)	(.73)	(.80)	(.81)	(.81)	(.91)	(.95)
PMAN	.22	.21	.21	.21	.20	.19	.19	.19	.18	.18
	(.089)	(.087)	(.085)	(.082)	(.082)	(.079)	(.077)	(.077)	(.073)	(.071)
PSERV	.18	.18	.18	.19	.20	.21	.21	.21	.22	.22
	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)	(.04)
BPR	.0050	.0050	.0047	.0045	.0044	.0044	.0048	.0048	.0046	.0042
	(.0013)	(.0014)	(.0014)	(.0014)	(.0012)	(.0012)	(.0013)	(.0014)	(.0013)	(.0014)
MTAXR	7.27	7.31	7.29	7.09	7.09	6.89	7.19	7.20	7.12	7.12
	(4.47)	(4.55)	(4.54)	(4.30)	(4.22)	(3.93)	(4.09)	(4.08)	(3.98)	(3.98)
CPRATE	0	0	0	0	0	0	3.02	2.38	4.17	3.13
							(.52)	(.42)	(.72)	(1.09)
INFRATE	3.38	3.52	3.62	3.85	4.22	4.44	4.65	5.23	5.88	6.84
	(1.48)	(1.53)	(1.43)	(1.55)	(1.59)	(1.74)	(1.60)	(2.03)	(2.14)	(*)

* This is a national average, regional disaggregates are not available after 1985.

TABLE 2: Collections Per Return and Returns Filed Per Capita*

	Dependent Variable	
	ICR	RCAP
ONE	–4.20	773.4
	(–2.14)	(4.46)
IAR(–1)	.28	–20.19
	(2.91)	(–3.33)
CPRATE(–1)	.009	9.57
	(.23)	(1.87)
STAXR(–1)	.004	–.71
	(.18)	(–.56)
PERED(–1)	.19	11.89
	(4.02)	(2.37)
PER45(–1)	3.96	–67.73
	(2.44)	(–.66)
PER65(–1)	1.32	–45.07
	(.89)	(–.68)
UR(–1)	–.45	–144.1
	(–.54)	(–2.02)
PICAP(–1)	.42	26.55
	(9.42)	(11.91)
PMAN(–1)	2.37	1.48
	(3.51)	(.06)
PSERV(–1)	.24	348.8
	(.19)	(6.60)
TIME	.02	–6.17
	(.98)	(–3.13)

* t-statistics in parenthesis

TABLE 3: Audit Rates and CP2000 Rates*

	Dependent Variable	
	IAR(−1)	CPRATE(−1)
ONE	14.47 (11.85)	−62.81 (−16.98)
STAXR(−1)	.03 (1.26)	−.039 (−1.13)
NEWED(−1)	.17 (2.48)	−1.46 (−2.29)
PER45(−1)	−8.9 (−5.67)	−1.85 (−.51)
PER65(−1)	.90 (.68)	−1.86 (−.97)
UR(−1)	−.54 (−.68)	−2.31 (−1.41)
PICAP(−1)	−.07 (−1.66)	−.05 (−.69)
PMAN(−1)	−.95 (−2.07)	−.42 (−.57)
PSERV(−1)	2.42 (2.68)	−.51 (−.43)
TIME	−.14 (−10.93)	.78 (21.06)
BPR(−1)	214.7 (8.70)	−27.08 (−.56)
INFRATE(−4)	−.03 (−.98)	.21 (6.65)

* t-statistics in parenthesis

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